DOCUMENT RESUME

ED 278 681 TM 870 098

AUTHOR Laveault, Dany; And Others
TITLE Application of Scale Analysis to the Cross-Cultural Evaluation of Intellectual Development.
PUB DATE [83]
NOTE 27p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Canada Natives; Cognitive Tests; Comparative Testing; *Cross Cultural Studies; Cultural Influences; Culture Fair Tests; Early Childhood Education; Foreign Countries; *Intellectual Development; Language Role; Mathematical Concepts; *Scaling; Spatial Ability; *Test Bias; *Test Theory
IDENTIFIERS French Canadians; Kolmogorov Smirnov Two Sample Test; *Montagnais (Tribe)

ABSTRACT

The main purpose of this study was to evaluate the cognitive processes of Montagnais Indians under conditions that would reduce bias and allow for a contextual interpretation of the results. Fifty-eight Montagnais children were compared to French-Canadians of the same age and grade groups whose data had been collected through previous experimentation. Two tests of logico-mathematical operations and two tests of spatial operations were administered to both groups. The results show no statistically significant difference between the performance of the Montagnais and the French-Canadians on these tests. No significant difference could be found either in the order of the stages' occurrence or in the age of accession of a stage. Furthermore, neither the logico-mathematical operations tests, nor the spatial operations tests could differentiate between the two groups. Item characteristics, however, were found to be potential cultural differentiators. A list of references and tabulated data follow the study. (Author/JAZ)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED278681

Application of Scale Analysis to the Cross-cultural Evaluation of Intellectual Development*

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

D. Laveault

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

by

Dany Laveault, Ph.D.**

Université d'Ottawa

and

Hedwige Noelting, M.A.

Université Laval

and

Gérald Noelting, D.Sc., Ph.D.

Université Laval

* This research was supported by a FCAC grant (Québec, #2709) to the second author from 1973 to 1976.

** Address reprints requests to: Dany Laveault, Faculté d'éducation, 651, rue Cumberland, Université d'Ottawa, Ottawa, Ontario K1N 6N5

TM 870 098

Application of Scale Analysis to the Cross-Cultural Evaluation of Intellectual Development.

Summary

The main purpose of this study was to evaluate the cognitive processes of Montagnais Indians under conditions that would reduce bias and allow for a contextual interpretation of the results. Fifty-eight Montagnais children were compared to French-Canadians of the same age and grade groups whose data had been collected through previous experimentation. Two tests of logico-mathematical operations and two tests of spatial operations were administered to both groups. Our results show no statistically significant difference between the performance of the Montagnais and the French-Canadians on these tests. No significant difference could be found either in the order of the stages' occurrence or in the age of accession of a stage. Furthermore, neither the logico-mathematical operations tests, nor the spatial operations tests could differentiate between the two groups. Item characteristics, however, were found to be potential cultural differentiators.

Application of Scale Analysis to the Cross-Cultural Evaluation of Intellectual Development.

As North-American Indian dialects are disappearing and as Indian parents are claiming more rights for an Indian education of their children, Canada is witnessing a movement for Indian control of education. In Quebec, Montagnais Indians have taken specific steps in order to gain control of education programs at the elementary school level and are demanding a bilingual training of their children, whose mother tongue, as well as French or English, would be a useful teaching and learning tool. Naturally such a bilingual system needs to be adapted to the Indians and requires a formal analysis of the Indian content of Education as well as the important aspect of the cognitive development of the child.

Till now, traditional intelligence tests applied to Montagnais children have given ambiguous results as far as the real potential of these children is concerned. According to Hénaire and Mailhot (1975), actual standardized procedures of testing are not appropriate for such children. These authors give as an example the case of five children who were first evaluated as above average and then, two months later, as mentally deficient. Similarly inconsistent is the fact that good results by Montagnais on aptitude tests are usually indicators of school success though, for important social reasons, the drop-out rate of the Montagnais is very high. The interpretation of poor results is even more confusing: they can be attributed as much to linguistic difficulties, as to low potential, cultural differences or inappropriate norms and testing conditions.

In the context of an Indian control of education, we have undertaken an evaluation research to assess more reliably the cognitive processes of Montagnais children and their course of development as compared to the course of development already assessed with the same instruments, in previous research, for French-Canadians.

Piagetian tests were used to assess cognitive processes and the level of development of the Montagnais children. Such tests have been used widely in cross-cultural research. It has been pointed out by Nyiti (1982) however, that although Piaget's theory has been "the single most widely used theoretical content for cross-cultural research during the past 20 years... the majority of cross-cultural Piagetian studies seem to suffer from ...: (1) inadequate knowledge of child's language and culture; and (2) the use of standardized rather than open interviews." Nyiti (1982) also reports that cross-cultural differences in cognitive development are no longer evident when children are questioned in their mother tongue by a native of their own culture, using an open interview technique. The Nyiti study, unfortunately, makes use of only one type of test: tests of conservation. It does not control for the kind of operations that are tested, nor for the way they are presented. Most of the cross-cultural studies using Piaget's developmental tasks have focussed on the period of concrete operations and on a very small sample of the operations of that stage (Brislin, 1973). Tests of physical conservation have been by far the most widely used, and cross-cultural researches have neglected to test children on a variety of other operations (either spatial or logico-mathematical) and item content (in term of specific tasks or contents of problems).

The main purpose of this study was to evaluate the cognitive processes of Montagnais under conditions that would reduce bias and allow for a contextual interpretation of the results. In accordance with the suggestion of Nyiti (1982), this evaluation was done using an open interview procedure in the children's mother tongue. In addition, each subject was submitted to tests that vary in notions or items' characteristics, for a better control of the test's cultural bias.

The main purpose in varying the kind of operations (notions) and item characteristics was to do more than merely increase the external validity of the research results. Careful sampling of notions and items characteristics may help to control the degree of cultural familiarity through the measurement of differential aspects of intellectual abilities for which there might be some cultural preferences or emphasis of which we are not aware. In addition, since it can hardly be demonstrated that a test is fair for any cultural group, one has to study how different notions or item characteristics influence the performance.

METHODOLOGY

Subjects:

Fifty-eight Montagnais children participated in the experiment. These children represented the entire population of Montagnais children attending school at the Louis-Hebert provincial school in Sept-Iles, Quebec. Their ages varied from 4 to 9 years, and they attended either nursery school or 1st to 3rd grade. Since these Montagnais children were located in a middle and lower socio-economical class district, French-Canadians samples were corrected in order to include in the total sample

- when feasible - only those who came from schools located in middle and lower socio-economical districts (Côté, Dussault, Doré, 1971).

The control group for the "Sharing Cookies" (SCT) and the "Orange Juice" test (OJT) was composed of 72 French-Canadians from schools Le Plateau, Charlesbourg and Sacré-Coeur. These schools are located in middle and lower socio-economical districts of Québec metropolitan area.

The same sample was used for the "Washing Lines" test (WLT) except that we lacked the necessary information from the report by Cauchon (1973) to sort 36 children from school Bonne Entente, Ste-Foy, located in a higher socio-economical class district. Thus, in this case, the French-Canadian sample (108 subjects) is not totally equivalent to the Montagnais group as far as the socio-economical district is concerned.

The control group for the "Graded Figures" test (GFT) was composed of 240 students aged five to nine from four schools of the Québec metropolitan area: Notre-Dame de la Paix and St-Esprit (lower socio-economical class districts) St-Odile and Marie-Victorin (middle and higher socio-economical class districts). In this case as well, we lacked the information to make the French-Canadian group totally equivalent to the Montagnais on the variable of socio-economical district of residence.

Since the Montagnais population is much lower and scattered than the French-Canadian, it has not been possible to sample Montagnais by age with the same tolerance level as for French-Canadian age groups. The tolerance level age groups has been set to $\pm$ 2 months for French-Canadians and to $\pm$ 6 months for the Montagnais on the SCT, OJT and WLT. In the case of the GFT, the Montagnais sample has been rearranged in order to make it comparable with the sample of Noelting (1973).

For example, according to this new grouping, any child from four years to four years and eleven months is considered to belong to the group of the four years old.

Instruments:

We used the developmental tests developed by Noelting (1980c, 1980d) -- tests similar to those previously invented by Piaget (1948, 1959). Noelting's tests use more items than Piaget's and thus make it possible to identify more intermediate levels within each of the stages already identified by Piaget. For each of these four tests we have norms available for the French-Canadian population. These tests were selected because of their primary importance for the elementary school curriculum and for their ability to discriminate two kinds of operations (spatial and logico-mathematical). Moreover, the two tests of proportion were chosen because they made it possible to present items that were formally the same through two different modes of presentation. These tests were:

A. Tests of logico-mathematical operations:

1. The "Sharing Cookies" test (SCT): this test involves "sharing" a number of cookies among a number of individuals. The problem is to determine which of two groups of individuals has more to eat "per capita", i.e. to compare two fractions a/b vs c/d. (Noelting, 1980d).
2. The "Orange Juice" test (OJT): this test consists of mixing a number (a) of glasses of orange juice with a number (b) of glasses of water. The problem is to determine which of two mixtures has the stronger taste, that is, to compare two

ratios of juice and water (a,b) vs (c,d), or two fractions of the total amount of liquid (e.g.: a/a+b vs c/c+d). (Noelting, 1980a,b; 1982)

B. Tests of spatial operations:

1. The "Graded Figures" test (GFT): this is a test of increasing complexity in geometrical patterns which the child must reproduce in a drawing (Noelting, 1980c). Correction criteria take account of size, identity, direction and line junction in evaluating each figure. The tests have been designed by Noelting (1980c) so that success or failure at any figure can be correlated with some stage of cognitive development.
2. The "Washing Lines" test (WLT): in this test of linear order, the child has to reproduce on another line the correct order of clothes on a model line. The items of linear order are respec- tively: direct, spaced, reverse, alternative. (Noelting, 1980d)

Procedure of experimentation:

To insure that intellectual discrepancies could not be attributed to language differences, testing of the Montagnais children was done in the Indian tongue by two Indian teachers who had received special training in the clinical method of testing. Each teacher was supervised by a professional psychologist during each interview.

Data on French-Canadians had been collected through previous experimentation. Data collection procedures were essentially the same as those used for Montagnais: both groups were tested individually by Piaget's clinical method in their own mother tongue, during school periods. The main difference in the testing procedure between the two

groups was that different interviewers were used to collect the data. Interviewers for French-Canadians were seven graduate students in psychology.

Procedure of data analysis:

The cross-cultural comparison of both groups using scale analysis was performed in three steps:

1. A coefficient of reproductibility (CR) and a minimum marginal reproductibility coefficient (MMR) using Guttman's method (1950) was computed for each test, as well as a percent of improvement coefficient (PPR) using Jackson's method (1949). In order to form a perfect hierarchical scale, each test must have adequate CR and PPR. The Cr's threshold has been set at 0.90 by Guttman (1950) and the PPR's threshold at 0.70 by Jackson (1949).
2. Items of each hierarchical scale having the same problem structure and of roughly the same level of difficulty were grouped. Subjects succeeding at items of one group and not another, were put together. These groups of subjects were then differentiated chronologically. Groups of items were assumed to be of different stages if age distribution of the subjects having reached the stage was statistically significant (in Siegel, 1956). A non parametric test, the Kolmogorov-Smirnov, was used to determine this. Once stages were validated chronologically, an age of accession was computed for each stage, to serve as a point of reference inside each group. The age of accession is the age at which 50% of the subjects pass an item.

3. Once the previous procedure had ascertained that both groups undergo the same stages of development, we preceeded to compare the cumulative distributions of ages of both groups for the same stage. The Kolmogorov-Smirnov was used again to determine if a significant difference exists between the two groups. The main differene between this procedure and the proceeding one, is that the Kolmogorov-Smirnov test is used to test a significant difference at the same stage for different groups. In step two, the Kolmogorov-Smirnov is used to test for a significant difference between different stages of the same group.

RESULTS

Scalability of the results and differentiation of stages:

Table 1 reveals that each test was fond to make up a perfect hierarchy in each group according to Guttman's (1950) and Jackson's (1949) criterion (CR 0.90 et PPR 0.70). Step two of the procedure analysis was then applied to the results. The same stages were found in each group and were differentiated chronologically at a 0.05 level of significance using the Kolmogorov-Smirnov test. Finally, the distribution of stages for each test was compared for each group. Step three was used in group comparison and the results are as follows.

(I) "Graded Figures" test:

Results obtained from the two groups give five different stages which were chronologically differentiated and found to

be the same as those already observed by Noelting (1980c). Table 2 lists all graded figures categorized by stage. The same order of difficulty was found for the various figures for both groups. Differences in the order of difficulty of items are minimal and always occur within the same stage. For example, the most important differences between the two groups occur for the "inscribed rhomb", which is more easily drawn by French-Canadians of ages 5 to 9 years. Comparatively, another figure of the same stage, "the flag", is better drawn by the Montagnais of ages 6 to 8 years. These differences affect ordering of items within the same stage. In all other cases, ordering of stages and of items within the same stages are strictly identical. These particularities are not statistically significant at a 0.05 level.

(II) "Washing Lines" test:

Five stages of development of the operation of linear order were differentiated chronologically and found to be similar to those already identified by Noelting (1980D). Table 3 lists these stages in their developmental order. This order is almost the same for both groups, and the progression of both groups as shown by their age of accession for each stage is almost identical. There is no significant difference between Montagnais and French-Canadians for this test at a 0.05 level of significance.

(III) "Sharing Cookies" and "Orange Juice" tests:

Similar stages appear in both tests of proportion and for both groups. One can observe that items of the SCT and OJT are grouped together into stages accroding to similar schemes. For example, Table 5 shows that items of stages IA and IB of the OJT are made up of fractions which can be solved through centration on only one term (such as juice or water only: e.g. 3,4 vs 4,4 or 1,2 vs 1,3). Although this is similar to the scheme that can be found in stage IA and IB of the SCT in table 4, the SCT is relatively easier than the OJT, and the ages of accession occur earlier for both groups in that test. For instance, the age of accession to the middle intuitive stage of the SCT is 5 years 10 months for the Montagnais and 4 years 5 months for the French-Canadians. For the OJT, the ages of accession to the same stage are 6 years 9 months and 6 years 2 months for the Montagnais and the French-Canadians respectively.

Both the SCT and the OJT do not show any statistically significant difference between the Montagnais and the French-Canadians at a 0.05 level. A closer look at the data, however, reveals some important qualitative differences. The Montagnais are somewhat more successful with the SCT, while the French-Canadians are more successful with the OJT. There is a discrepancy, increasing with age, between the cumulative age distributions of each group for each test. The Montagnais' results at the middle intuitive stage of the SCT place them 1 year and 5 months behind the French-Canadians. At the late intuitive stage and the early

concrete operations stage the reverse is true: Montagnais are then in advance of the French-Canadians by 1 year and 1 month and 1 year and 4 months respectively. The picture is the opposite for the CJT; the Montagnais' results at the middle intuitive stage place them 7 months behind the French-Canadians. Instead of catching up and surpassing the French-Canadians, however, the Montagnais' deficit increases even more, at the late intuitive stage, to reach 1 year and 10 months. The probability of such differences in ages of accession at the early concrete operation of the SCT and at the late intuitive stage of the CJT is close to the 0.05 level. Such low probability leads to the possibility that the content of a proportion problem (in this case, either cookies to share or juice to mix with water) is increasingly important with respect to age and development. Test results from older children would be required to confirm this trend.

Conclusion:

Our results show no statistically significant difference between the Montagnais and the French-Canadians when an open interview technique is used and when tests are administered in the Indian mother tongue. No significant difference could be found either in the order of the stages' occurence or in the age of accession of a stage. No significant difference that could be found either on logico-mathematical operations tests or on spatial operations tests. Furthermore, no significant difference have been found on the GFT and WLT despite the fact that, in these two cases, the French-Canadian samples did include children whose school were locaded in socio-economical class districts.

Despite these overall similarities, control of item characteristics on both tests of proportions has shown the existence of a trend leading to increased differentiation between Montagnais and French-Canadians on these two tests. As reported earlier, eight to nine-year-old Montagnais performed better on the SCT while the French-Canadians performed better on the OJT, though the items for both tests were built according to similar schemes.

The lower performance of the Montagnais on the OJT might be explained by the unusual presentation of the proportion problem at the OJT. While the sharing cookies situation is familiar to children of both cultures, Indian natives have suggested to us afterward that a ratio of hot tea to hot water might have been better suited than a juice-water ratio. That this possibility did not lead to a difference so large as to be statistically significant at a 0.05 level could be attributed to the moderating effect of an open interview technique. In such a procedure, the interviewer must take care that the task has been clearly understood by the subject, and that the subject has had as many opportunities as he wishes to deal with the problem. A standardized interview procedure would have prohibited the interviewer from doing this, and thus might have resulted in larger differences among groups, especially in cases in which there is a potential cultural bias.

More research is required to assess the cultural fairness of both "standardized" and "open" technique interviews. Using Piaget-like tests with an open interview technique in the Indian mother tongue did not yield any significant difference between Montagnais and French-Canadians. According to our results, such a procedure could be

considered as relatively culture-fair. Our results do not alow us to determine more specifically, however, what are the aspects of our procedure that are the most effective in controlling cultural bias: was it test administration in the child's mother tongue, the use of natives as interviewers, the open interview technique or the tests themselves? Finally, control of item characteristics was found to be a potential procedure to assess the importance of cultural bias and insure greater generalisability of future cultural research. A better understanding of the item characteristics and testing procedures could also permit a better control of cultural bias in cross-cultural evaluation. Future cross-cultural research should take care in controlling as many of these factors as is feasible.

REFERENCES

Brislin, R.W.; Lonner, W.J.; Thorndike, R.M. (1973). Cross-cultural Research Methods. N.Y.: John Wiley and Sons.

Cauchon, C. (1973). Étude de la notion de l'ordre linéaire chez les enfants de 4 à 9 ans. Unpublished Master's thesis, Université Laval, Québec.

Côté, C.; Dussault, G.; Doré, G. (1971). Les zones prioritaires de Québec. Rapport de recherche Ezop-Québec, COBEQ, Québec.

Guttman, L. (1950). The Basis for Scalogram Analysis, in Stouffer, S.A. et al., Measurement and Prediction, N.Y.: Princeton University Press.

Jackson, J.M. (1949). A simple and more rigorous technique for scale analysis. In A Manual of Scale Analysis, Part II. Montréal: McGill University.

Noelting, G. (1980a). The development of proportional reasoning and the ratio concept. Part I: Differentiation of stages. Educational Studies in Mathematics, 2, 217-253.

Noelting, G. (1980b). The development of proportional reasoning and the ratio concept. Part II: Problem-structure of successive stages; problem-solving strategies and the mechanism of adaptive restructuring. Educational Studies in Mathematics, 2, 331-363.

Noelting, G. (1981). Qualitative and quantitative aspects in the developments of proportional reasoning In Friedman, M.P., Das, J.P. and O'Connor, N. (Eds) Intelligence and Learning. N.Y.: Plenan.

Noelting, G. (1982). Les mécanismes de l'équilibration. Chicoutimi: Gaétan Morin.

Noelting, H. (1973). Relation des stades de développement de la figure géométrique avec ceux de la notion de proportion numérique. Unpublished Master's thesis, Université Laval, Québec.

Nyiti, R.M. (1982). The validity of "cultural differences explanations" for cross-cultural variation in the rate of Piagetian cognitive development In Wagner, D.A. and Stevenson, H.W. (Eds) Cultural Perspectives on Child Development. San Francisco: W.H. Freeman and Co.

Piaget, J. and Inhelder, B. (1948). La représentation de l'espace chez l'enfant. Paris: Presses Universitaires de France.

Piaget, J. and Inhelder, B. (1959). La génèse des structures logiques d'élémentaires. Neuchâtel: Delachaux et Niestlé.

Siegel, S. (1956). Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill Book Company.

REFERENCE NOTES

Hénaire, J. and Mailhot, J. (1975). Rapport d'activités en milieu scolaire montagnais. Unpublished manuscript. Université du Québec à Chicoutimi.

Noelting, G. (1980c). Scalex: figures graduées. Unpublished manuscripts. Université Laval, Québec.

Noelting, G. (1980d). Scalex: ordre et espace. Unpublished manuscripts. Université Laval, Québec.

Tables to be inserted in text

Table 1

Guttman and Jackson coefficients

for each cognitive test

	CR		MMR		PPR	
	EG	CG	EG	CG	EG	CG
TESTS						
Sharing Cookies	0.987	0.947	0.805	0.793	0.933	0.745
Orange Juice	0.996	0.941	0.863	0.792	0.971	0.716
Washing Lines	1.000	0.984	0.733	0.764	1.000	0.933
Graded Figures	0.986	0.941	0.881	0.850	0.757	0.832

Legend:
EG: experimental group (Montagnais)
CG: control group (French-Canadians)
CR: coefficient of reproductibility (Guttman, 1950)
MMR: minimal marginal reproductibility
PPR: percentage of improvement over MMR (Jackson, 1949).

Table 2

Percentages of success at the "Graded Figures"

test shown by age and by item for each group.

EG: experimental group (Montagnais)
CG: control group (French-Canadian)

N.B. Age groups are made up of students of exact age up to eleven months more. (e.g.: 5 years old are aged from 5 years to 5 years, 11 months)

			Age groups					
Stage*	Figure**	Group	5	6	7	8	9	Total
IA	Square	EG	100	100	100	100	100	100
		CG	95	100	100	100	100	99
IB	The "X"	EG	93	100	100	100	100	98
		CG	98	100	98	100	100	99
	Intersecting circles	EG	93	87	100	100	100	94
		CG	85	100	100	100	100	97
	Triangle	EG	93	100	100	100	100	98
		CG	91	100	100	100	100	98
IC	Rhomb	EG	100	100	100	100	100	100
		CG	50	94	94	98	98	87
	Tangent circles	EG	47	87	100	100	100	81
		CG	52	78	94	96	94	83
	Snow Shoe	EG	53	47	70	80	88	58
		CG	37	94	92	100	100	85
IIA	Flag	EG	7	53	70	100	63	53
		CG	7	22	39	81	82	46
	Inscribed rhomg	EG	0	13	20	20	38	15
		CG	4	32	50	83	88	51
IIB	Shifted squares	EG	0	0	20	0	25	8
		CG	0	6	12	32	35	17
	N	EG	15	15	10	5	8	53 ***
		CG	48	48	48	48	48	240

LEGEND: *IA: early intuitive
IB: middle intuitive
IC: late intuitive
IIA: early concrete operations
IIB: late concrete operations

** List of figures

- Square:
- The "X":
- Intersecting circles:
- Triangle:
- Rhomb:
- Tangent circles:
- Snow shoe:
- Flag:
- Inscribed rhomb:
- Shifted squares:

*** The results of the 4;00 to 4;11 years old Montagnais on this test are not reported since we lack a comparable group among French-Canadians.

Table 3

Percentages of success at the "Washing Lines"

test shown by age and by stage

EG: experimental group (Montagnais: age 6 months)
CG: control group (French-Canadian: age 2 months)

			Age groups (years)						Age of accession **
Stage*	Description	Group	4	5	6	7	8	9	Years and months
IA	Failure of one-one correspondence	EG	100	100	100	100	100	100	
		CG	100	100	100	100	100	100	
IB	One-one correspondence	EG	33	100	94	100	100	100	4;3
		CG	44	78	100	100	100	100	4;3
IC	Same as IB, but without proximity	EG	0	17	75	100	100	100	5;9
		CG	11	44	94	94	100	100	5;2
IIA	Reverse order	EG	0	0	38	89	89	100	6;5
		CG	6	6	44	89	89	100	6;3
	N	EG	3	12	16	9	9	9	58
		CG	18	18	18	18	18	18	108

LEGEND:
*0: symbolic
IA: early intuitive
IB: middle intuitive
IC: late intuitive
IIA: early concrete operations
IIB: late concrete operations

** Age of accession: it is the age at which 50% of the subjects pass an item.

Table 4

Percentages of success at the "Sharing Cookies"

test shown by age and by stage

EG: experimental group (Montagnais: age 6 months)
CG: control group (French-Canadian: age 2 months)

			Age group (years)						Age of accession **
Stage	Example***	Group	4	5	6	7	8	9	Years and months
0	1/1 vs 0/1	EG	100	100	100	100	100	100	
		CG	100	100	100	100	100	100	
IA	1/3 vs 2/3	EG	100	92	100	100	100	100	
		CG	92	92	100	100	100	92	
IB	1/2 vs 1/3	EG	0	25	69	78	78	100	5;10
		CG	50	50	58	92	92	92	4;5
IC	3/4 vs 2/1	EG	0	17	63	44	67	78	7;0
		CG	0	8	17	25	42	75	8;1
IIA1	1/2 vs 2/4	EG	0	0	25	44	56	67	7;6
		CG	0	8	8	17	25	58	9;0
IIA2	3/1 vs 6/2	EG	0	0	13	22	22	44	58
		CG	0	8	8	17	17	8	72
	N	EG	3	12	16	9	9	9	
		CG	12	12	12	12	12	12	

LEGEND:

* 0:	symbolic
IA:	early intuitive
IB:	middle intuitive
IC:	late intuitive
IIA:	early concrete operations
IIA2:	middle concrete operations

** Age of accession: it is the age at which 50% of the subjects pass an item.

*** a/b vs c/d: a and c represent the number of cookies; b and d represent the number of children.

Table 5

Percentages to success at the "Orange Juice"

test shown by age and by stage

EG: experimental group (Montagnais: age 6 months)
CG: control group (French-Canadian: age 2 months)

			Age groups (years)						Age of accession **
Stage*	Example***	Group	4	5	6	7	8	9	Years and months
0	(1,0) vs (0,1)	EG	100	100	100	100	100	100	
		CG	100	100	100	100	100	100	
IA	(1,4) vs (4,1)	EG	33	83	88	100	100	100	
		CG	100	92	100	100	100	100	
IB	(1,5) vs (1,2)	EG	0	17	44	56	67	67	6;9
		CG	50	33	33	67	83	83	6;2
IC	(2,1) vs (3,4)	EG	0	0	25	11	33	63	8;9
		CG	42	0	25	58	67	75	6;11
IIA	(1,1) vs (2,2)	EG	0	0	6	0	11	38	
		CG	8	0	0	8	25	58	
IIB	(2,3) vs (4,6)	EG	0	0	6	0	11	13	
		CG	0	0	0	0	8	42	
	N	EG	3	12	16	9	9	9	58
		CG	12	12	12	12	12	12	72

LEGEND:

* 0: symbolic
IA: early intuitive
IB: middle intuitive
IC: late intuitive
IIA: early concrete operations
IIB: late concrete operations

** Age of accession: it is the age at which 50% of the subjects pass an item, when such an age can be computed for both groups.

** (a,b) vs (c,d): a and c represent the number of glasses of juice ; b and d represent the number of glasses of water.